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Operational Space-Based Crop Mapping Protocols at AAFC

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1. Introduction

Space-Based Crop Mapping at AAFC

- Starting in 2009, AAFC began the process of generating annual crop type digital maps using satellite imagery.
- Mapping focused on Prairie Provinces in 2009 & 2010, but was expanded to entire agricultural extent of Canada in 2011.
- Optical multi-spectral data (Landsat, DMC, AWiFS) adequate to classify crops if data available during critical time periods.
- Although accuracies greater than 85% are achievable, they are lower if gaps in optical data collection occur.
- The use of dual-polarization with one frequency (VV and VH) improves accuracies where gaps in optical data exist.
- **Overall, integrating SAR data with an adequate national optical coverage significantly improves the accuracy of AAFC's annual crop inventory.**




2. Ground Data Collection

Ground Sampling

- Used to train classification model and validate results.
- Derived from Crop Insurance Agencies or collected by AAFC.
- Ancillary information useful if available (cultivar, phenology).

a) Crop Insurance Information:

- Derived from Provincial Crop Insurance Agencies.
- The most accurate, detailed and complete source of crop type information.
- Bias may exist because some crops more likely to be insured than others.

b) AAFC "Windshield Surveys":

- Derived from AAFC field surveys.
- Not as accurate, detailed or complete as crop insurance information.
- Requires investment of money and time.

3. Satellite Data Collection

Satellite Data

- Successful crop identification relies on image acquisitions during key growth stages.
- Crop classification accuracies increase with multi-temporal imagery.

a) Optical Satellite Data:

- Landsat-5, -7 and -8; AWiFS; DMC; SPOT-5
- Current AAFC operations rely heavily on Landsat-8 (30m) from USGS.
- Images acquired three times during each growing season.
- Data gaps can occur in certain regions because of sustained cloud cover.

b) Synthetic Aperture Radar (SAR) Data:

- RADARSAT-2 (Wide beam mode W2: 150km swath; ~25m resolution).
- Integration of SAR can increase optical-based mapping accuracies by 5-15%.
- Best separation of crops uses ascending mode dual-pol (VV, VH) data.

4. Data Preparation

a) Training and Validation Data:

- Quality assurance; legend cross-walk and generalization.

b) Image Orthorectification:

- Orthorectification using satellite-specific orbit models and DEMs.

c) RADAR filtering:

- Elimination of noise in SAR data.

d) Masking Clouds and Shadow in Optical Data:

- Semi-automated cloud and shadow masking using FMASK (Boston U).

e) Masking Urban Landscapes:

- Urban masks derived from Circa 2000 AAFC LC.

5. Classification and Validation

- Decision Tree (DT) Classification:
  - AAFC uses Decision Tree (DT) classifiers operationally.
  - DT methods are able to handle discrete data, have higher processing speeds, are independent from the distribution of class signatures (particularly important for SAR), and are more easily interpreted.
  - Implemented in iterations that successively classifies the landscape into detailed crop classes, adds permanent classes, and post-classification filtering.
- Accuracy Assessment (Validation):
  - Crop mapping accuracy at the field level are evaluated using independent crop insurance and AAFC-derived windshield survey observations.
  - Low mapping accuracies require aggregation of certain detailed mapped classes.
  - Accuracies provided on a crop-specific and Province-specific basis in Metadata for final output products.

Data published through http://data.gc.ca/

6. Publication (data.gc.ca)